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ECOLOGICAL SAMPLING AND ANALYSIS PLAN ADDENDUM SUPPLEMENTAL RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION/REMEDIAL INVESTIGATION PHASE 2 NAS KEY WEST FL

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BROWN AND ROOT ENVIRONMENTAL

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ECOLOGICAL SAMPLING AND ANALYSIS PLAN ADDENDUM

SUPPLEMENTAL RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION
PHASE II
FOR
NAVAL AIR STATION KEY WEST
BOCA CHICA KEY, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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1.0 INTRODUCTION

This sampling and analysis plan addendum describes the ecological sampling to be conducted at three solid waste management units (SWMUs), four Installation Restoration (IR) Sites, and one Area of Concern (AOC) at Naval Air Station (NAS) Key West. This addendum is provided in accordance with the Supplemental Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) Work Plan and Sampling and Analysis Plan (SAP) prepared by ABB Environmental, Inc., dated December 6, 1995. The sites to be investigated include SWMU-4, SWMU-5, SWMU-7, IR-1, IR-3, IR-7, IR-8, and AOC-B.

No biological sampling at these eight sites has been conducted as part of the RFI/RI process to date. Based on the results of contaminant screening described in the RFI/RI report (IT, 1994), Brown & Root Environmental (B&R ENVIRONMENTAL) proposes to conduct tissue analyses of biological samples collected at seven of the eight sites to obtain additional information on the toxicity of contaminants to ecological receptors at those sites. Chemical analyses of tissue will provide a direct measurement of contaminant accumulation in ecological receptors. This is especially important where migration of contaminants to marine waters is potentially occurring.

The objectives of the ecological (i.e., biological) sampling are to measure contaminant concentrations in ecological receptors at or near the sites using laboratory tissue analysis; and to determine the potential impacts on individual organisms resulting from exposure to contamination, and subsequent community-level effects, if any. Thus, the ecological effects of site-associated contamination will be assessed by characterizing the nature and extent of contamination in biota located at the sites.

This document provides details of the biological sampling events to be conducted at the sites mentioned above, as well as at five locations that have been chosen to represent background conditions in the Key West area. Three background locations and four SWMUs on Boca Chica Key were sampled in January and February, 1996. Procedures and protocols for sampling and analyses of groundwater, surface water, sediment, and soil will be conducted in accordance with the final work plan and SAP submitted by ABB Environmental Services (1995), and are not discussed in this addendum.

Section 2.0 of this document describes each investigation site and associated ecological sampling requirements. Section 3.0 provides similar information on background sites. Section 4.0 briefly describes the life histories of aquatic organisms selected for collection. Section 5.0 describes sampling procedures and protocols.

Pertinent documents were reviewed prior to the preparation of this sampling plan addendum, with emphasis on two documents: (1) Ecological Survey of U.S. Navy Property in the Lower Florida Keys, Monroe County, Florida, August 1994, prepared by the Florida Natural Areas Inventory; and (2) Final Report of RFI/RI (Phase I) for NAS Key West, June 9, 1994, by IT Corporation. In addition, B&R ENVIRONMENTAL biologists conducted a qualitative ecological survey of all sites during June 24-27, 1996. During the survey, potential ecological receptors and exposure pathways were investigated, and habitats were characterized by identifying vegetative cover types and dominant taxa. Based on the field surveys, locations have been determined from which soil, water, sediment, and biological samples will be collected for chemical analyses.

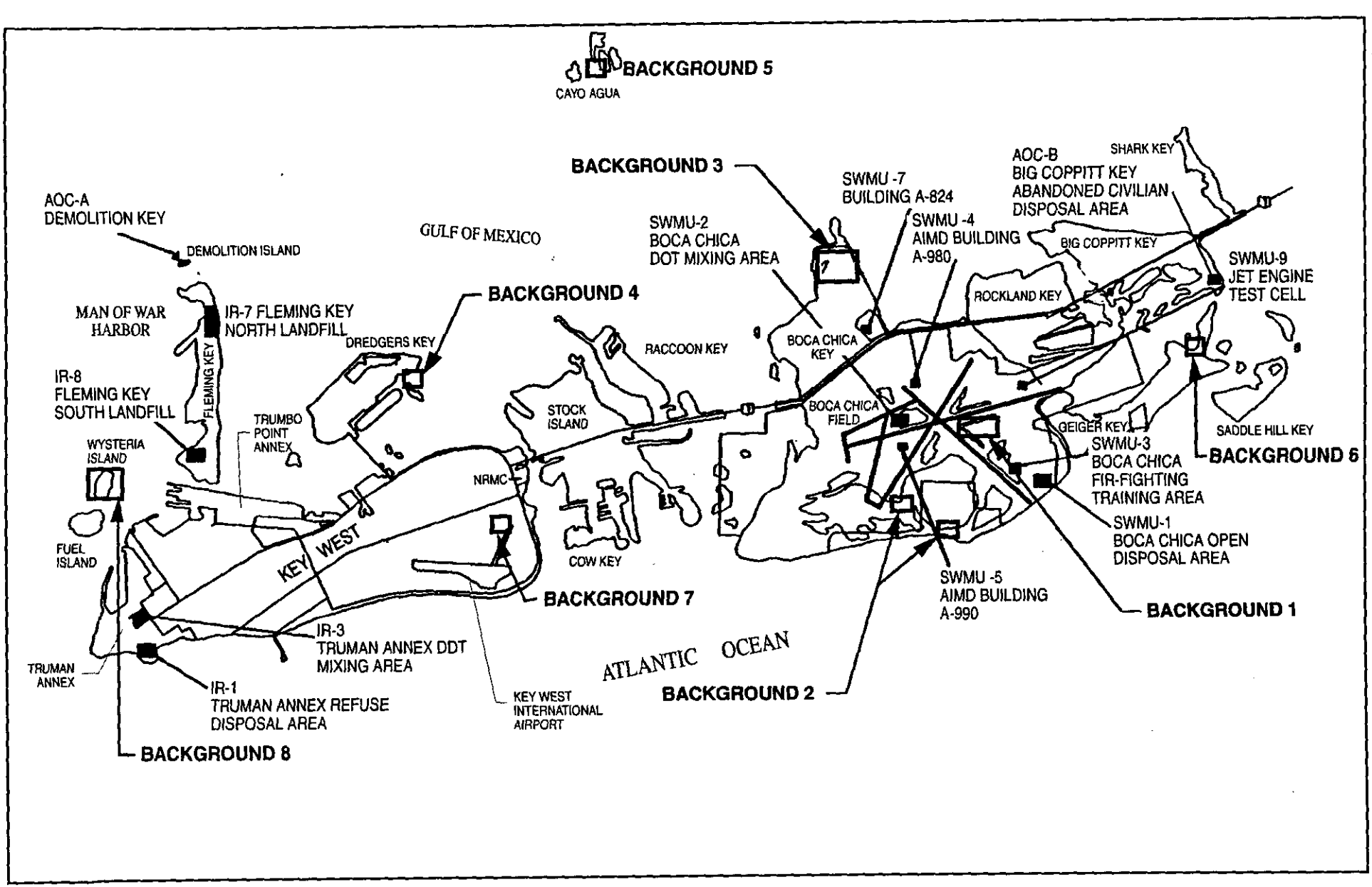
2.0 INVESTIGATION SITES AND ACTIVITIES

Site locations are shown in Figure 2-1, and the number and types of samples proposed for collection and subsequent laboratory analyses are listed in Table 2-1. Site descriptions, histories, and previous sampling results are discussed in detail in Appendix K of the RFI/RI (IT, 1994) and are summarized in the RFI/RI Work Plan and SAP (IT, 1994).

Standard laboratory toxicity tests, using a variety of species introduced to surface-water, sediment, and soil samples, were considered for this project. However, the results of toxicity tests depend on a variety of factors (salinity, test species, etc.) and conclusions from such tests are often confounded by conditions other than site-related contamination. Tissue analysis, on the other hand, provides a direct measurement of contaminant accumulation. Thus, biological sampling will be limited to tissue analyses, and toxicity tests will not be conducted in this study. Previous investigations at other SWMU and at three background sites on Boca Chica Key in January-February, 1996 employed toxicity testing. The results of these extensive tests were inconclusive and led to the decision that further toxicity tests would be of limited value at NAS Key West.

In general, aquatic sampling sites at NAS Key West consist either of water bodies with little or no connection to marine waters, and sites that are adjacent to the Gulf of Mexico or the Atlantic Ocean. Aquatic biological samples at the "inland" sites will consist largely of fish and crabs. Most of the inland sites are shallow water lagoons where only minnow-sized fish are expected. Nevertheless, larger fish will be collected from these sites if available. However, fish will not be targeted for collection from the "shoreline" sites. Since these sites are adjacent to open marine waters, it is assumed that fish are transient in these areas. Thus, the analyses of fish tissue from waters near these sites would probably not provide useful data. Aquatic biological samples at shoreline sites will consist of species that are less transient than fish. Primary target organisms at shoreline sites are crabs and sea urchins, supplemented by clams, oysters, snails, lobsters, seagrass, etc. (See Section 4.0).

The sampling of macroinvertebrates was considered for this sampling plan, but macroinvertebrates are so small that collection of a quantity sufficient for tissue analyses of more than a few samples would not be feasible. A study of the abundance and diversity of macroinvertebrates was also considered. However, the unique nature of each proposed sampling site would probably result in differing macroinvertebrate community structure among sites, even in the possible absence of contamination. Thus, macroinvertebrate sampling is not proposed for this project.



Brown & Root Environmental

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SCALE IN MILES (APPROXIMATE)

FIGURE 2-1. NAS KEY WEST BACKGROUND LOCATIONS AND HAZARDOUS WASTE SITES

NAS KEY WEST — KEY WEST, FLORIDA

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TABLE 2-1

NUMBER OF BIOLOGICAL SAMPLES PROPOSED FOR COLLECTION AND CHEMICAL ANALYSIS
NAS KEY WEST
BOCA CHICA KEY, FLORIDA

Site	Fish	Crab	Sea Urchin and Other[1]	Terrestrial Vegetation[2]	Aquatic Vegetation
SWMU-4	15	5	-	3	-
SWMU-5	15	5	5	3	-
SWMU-7	-	-	-	3	-
IR-1	-	10	10	-	3
IR-7	-	10	10	-	3
IR-8	-	10	10	-	3
AOC-B	25	10	10	-	-
Background Sites					
Background 4 (Dredgers Key)	-	10	10	-	3
Background 5 (Cayoagua Island)	-	10	10	-	3
Background 6 (Coppitt Key)	15	10	-	-	-
Background 7 (Eastern Key West)	15	10	-	-	-
Background 8 (Wisteria Island)	-	10	10	-	3
Total Analyses:	85	95	75	9	18
Total Analyses: 282					

[1] Depending on availability, sea urchins will be supplemented with species such as clams, oysters, lobsters, snails, etc.
[2] Terrestrial vegetation will be sampled only where habitat for the endangered lower keys marsh rabbit exists on or near the site.

2.1 SWMU-4, BOCA CHICA AIMD BUILDING A-980

A large, shallow (<8 inches) lagoon is located north of AIMD Building A-980. The lagoon receives surface-water runoff, and possibly groundwater seepage, from the area surrounding AIMD Building A-980. Wading birds are known to forage on small minnows in this area. Therefore, minnows will be collected from the lagoon to determine body burdens of contaminants in aquatic receptors and possible food chain transfer. In addition, because the marshy areas surrounding the lagoon are utilized by the endangered lower keys marsh rabbit (*Sylvilagus palustris hefneri*), vegetation samples will be collected from plant species known to be used as forage by this mammal. Crabs are probably rare at this site (none were seen during the June 1996 site visit) but will be collected, if possible.

2.2 SWMU-5, BOCA CHICA AIMD BUILDING A-990

Runoff from this site drains to a concrete ditch, then through a grassy swale into a small, shallow ponded area west of the site. The ponded area is connected to a large lagoon by a culvert underneath a paved road. Aquatic receptors suitable for collection and tissue analysis from this ponded area may be limited to minnows. Therefore, minnows will be targeted for sampling. Terrestrial plant species known to be used as forage by marsh rabbits will be sampled from the grassy area between the end of the concrete drainage ditch and the ponded area west of the site.

2.3 SWMU-7, BOCA CHICA BUILDING A-824

A small pond, 30 ft x 30 ft in area, is located approximately 50 ft north of a chain link fence surrounding Building A-824. A short ditch cut into the surficial limestone adjoins the south end of the pond. Because of the small size of the pond and ditch, and their poor quality as aquatic habitat, no aquatic biological sampling is proposed. However, since the nearby area is known to be inhabited by marsh rabbits, vegetation samples will be collected from plant species known to be consumed by rabbits.

2.4 IR SITE 1, TRUMAN ANNEX OPEN DISPOSAL AREA

IR Site 1 is located adjacent to the Atlantic Ocean shoreline. The shoreline receives surface water runoff from the site, and groundwater beneath the site presumably seeps into the ocean. Because fish are transient in open marine waters, the analyses of fish tissue from water adjacent to this site would probably not provide data useful for a determination of site-related contamination. It is anticipated that crabs and sea urchins will be the most appropriate organisms to collect for tissue analyses. Sessile filter feeders, such as clams and oysters, are known to accumulate contaminants from the water column, and will be collected if available in quantities sufficient for laboratory analyses. Seagrass will also be collected for laboratory analyses.

2.5 IR SITE 3, TRUMAN ANNEX DDT MIXING AREA

The use of this small (¼ acre) area of turf grass by ecological receptors is insignificant. In addition, remediation of contaminated soil has been conducted at this site. As a result, no biological sampling is proposed for IR-3.

2.6 IR SITE 7, FLEMING KEY NORTH LANDFILL

This site is bounded on the east and west by the Gulf of Mexico. Both shorelines receive surface water runoff, and presumably groundwater seepage, from IR-7. Crabs and sea urchins are proposed as the most appropriate organisms to collect for tissue analyses. Sessile filter feeders, such as clams and oysters, will be collected if available in quantities sufficient for laboratory analyses. Seagrass will also be collected for laboratory analyses.

2.7 IR SITE 8, FLEMING KEY SOUTH LANDFILL

This site is adjacent to the Gulf of Mexico. The marine waters along the site receive surface water runoff, and presumably groundwater seepage, from IR-8. Species targeted for collection are the same as at IR-1 and IR-7 and consist of crabs, sea urchins, clams, oysters, and seagrass, if available.

2.8 AOC-B, BIG COPPITT KEY ABANDONED CIVILIAN DISPOSAL AREA

A canal near the north end of this site presumably receives surface water runoff and groundwater seepage from AOC-B. The canal is not connected to marine surface water. The aquatic habitat at this site differs from other sites by being deep enough for large fish that do not have access to open marine waters. Fish and crabs are proposed for collection from the canal. The number of fish targeted for collection at this site (n=25) includes 15 minnow composite samples and 10 larger fish taken in gill nets.

3.0 BACKGROUND SAMPLING LOCATIONS

In addition to biological sampling at the sites discussed above, five background sampling areas will be investigated. At each background site, biological and nonbiological samples will be collected for analysis. Analytical results from these background sites and from three previously sampled background sites on Boca Chica Key will form the basis for background comparison to SWMU/IR/AOC samples for both biological and nonbiological/contaminant samples.

3.1 BACKGROUND 4 (DREDGERS KEY)

Dredgers Key is ½ mile north of Key West and 1 mile east of Fleming Key. Various U.S. Navy facilities exist on the island, including the Navy Exchange and Commissary, and several homes. The northeastern portion of the island is relatively undeveloped. Mangroves grow adjacent to a narrow sandy shoreline in this area, and sea grass communities exist in nearshore waters. A small, undeveloped, mangrove-covered island is located approximately 200 meters south of the eastern tip of Dredgers Key; biological samples will be collected in the water between Dredgers Key and the nearby mangrove island. Crabs and sea urchins are proposed as primary species for tissue analyses, with seagrass oysters, clams, etc. as available.

3.2 Background 5 (Cayoagua Island)

Cayoagua is a group of four small mangrove islands located in the Gulf of Mexico approximately 3 miles north of Stock Island. The islands are largely covered by mangroves, and no buildings or structures of any type exist on the islands. Sea grass communities occur in the vicinity of the islands. Samples targeted for collection are the same as at Background 4, and consist of crabs and sea urchins, with oysters, clams, seagrass, etc. as available.

3.3 BACKGROUND 6 (COPPITT KEY)

Background 6 is a shallow lagoon in the relatively undeveloped eastern portion of Coppitt Key. Scattered mangroves occur along the shoreline. Organisms targeted for collection here consist primarily of minnows and crabs.

3.4 BACKGROUND 7 (EASTERN KEY WEST)

Background 7 is located in the northeastern section of a large pond/lagoon north of the Key West International Airport. The eastern edge of the lagoon is covered by mangroves. Samples will be collected from locations in the area that appear to be least impacted by development. Organisms targeted for collection here consist primarily of minnows and crabs.

3.5 BACKGROUND 8 (WISTERIA ISLAND)

Wisteria Island is located approximately ½ mile northwest of Key West. No development exists on the island, which is covered with Australian Pines. The sandy shoreline consists of crushed limestone and coral. Samples targeted for collection are the same as at Background 4, and consist of crabs and sea urchins, with oysters, clams, seagrass, etc. as available.

4.0 AQUATIC SPECIES PROPOSED FOR SAMPLING

4.1 FISH

Several small, minnow-like fish species are found in the lower Florida Keys. The most common minnows found at the sites described above include the sailfin molly (*Poecilia latipinna*), mosquitofish (*Gambusia* sp.), sheepshead minnow (*Cyprinodon variegatus*), killifish (*Fundulus* sp.), crested goby (*Lophogobius cyprinoides*), and fat sleeper (*Dormitor maculatus*). The sailfin molly feeds mostly on algae and vascular plants, but will eat mosquito larvae when available. Mosquitofish feed primarily on mosquito larvae, but also eat larvae of other insects and zooplankton. Gobies and sleepers feed on small crustaceans and insect larvae. Killifish and sheepshead minnow are omnivorous, feeding on algae, insect larvae, small crustaceans, and annelid worms. All of these species are relatively short lived, less than three years in most instances. Schools of minnows (some of which were identified as sheepshead minnow) were observed in the small ponds at SWMU-4 and SWMU-5 during the June 1996 site visit.

Larger predators, such as ladyfish and tarpon, are also found in NAS Key West ponds and lagoons and may be present at AOC-B. Ladyfish (*Elops saurus*) tolerate a wide range of salinities, occurring in low-salinity estuaries and tidal creeks as well as offshore in the open ocean. Ladyfish are primarily piscivorous, feeding on menhaden, mosquitofish, pinfish, sheepshead minnows and other small bait fish. They may live as long as 10 years. Tarpon (*Megalops atlanticus*) also occur in coastal waters, where they feed on crabs and small fish. Tarpon reach sexual maturity at six or seven years of age and may live as long as 15-20 years.

4.2 SEA URCHIN

Sea urchins are members of the Class Echinoidea, which includes sea urchins and sand dollars. Most sea urchins are adapted for life on hard bottoms, on which they move with their tube feet and to a lesser extent their spines. They graze on algae and other microorganisms attached to rocks and shells, scraping the encrusted algae with their complex jaw apparatus, called Aristotle's lantern. Most sea urchins are secretive, hiding during the day in protected locations (among coral, in rock crevices) and emerging at night to feed in the open. Sea urchins require relatively clean, well oxygenated, circulating water, and avoid still, shallow areas that are silty or that become too hot during the day (above 35°C). Sea urchins grow rapidly in the first two years of life, then growth slows considerably. They may live as long as four or five years. Known predators of sea urchins include wrasses (e.g., the hogfish), triggerfishes, grunts, porgies, porcupinefishes, and toadfishes. Several species of sea urchin are found in Key West waters.

These include the long-spined black sea urchin, the brown rock urchin, and several rock-boring and reef urchins of the genus *Echinometra*. Population densities of sea urchins appear to be particularly high in the vicinity of IR-7 and IR-8.

4.3 BLUE CRAB

Blue crabs (*Callinectes* sp.) belong to the "swimming crab" family Portunidae, whose members include the lady crabs of the genus *Ovalipes* and the speckled crab, *Arenaeus cribarius*. The fifth set of legs (hind legs) in this group are flat and paddle-shaped, adapted for swimming. The blue crab is harvested by commercial fishermen throughout Florida coastal waters. Female blue crabs spawn in high salinity bays or offshore ocean waters where eggs hatch into planktonic larvae. Planktonic larvae begin developing in the open ocean and then migrate as post-larvae into estuaries where they settle to the bottom and continue growing and molting, ultimately becoming mature adults. Mating occurs in lower salinity estuaries. The females then migrate back to high salinity areas to spawn while the males remain in the estuaries. In nearshore areas, blue crabs are generally found in shallow water over sand or mud bottoms and are often associated with submerged aquatic vegetation. Blue crabs have a varied diet, and will feed on many species of animals including fiddler crabs. They will also eat dead and dying animals. Blue crabs are believed to be present at most, if not all, of the SWMUs and IR sites that have an outlet to the Atlantic Ocean or the Gulf of Mexico. Fish that feed on crabs include tarpon, cobia, snook, bonefish, skates, and rays.

4.4 STONE CRAB

The stone crab (*Menippe mercenaria*), another important commercial species, is found along the southwest Gulf Coast from the Florida Keys to Tampa Bay. Juvenile stone crabs are found in estuaries with shell, rock, or sea grass substrates, but adult crabs move to deeper water, where they burrow in soft substrates or live in sea grasses. Stone crabs belong to the family Xanthidae, which includes the stone crab and a number of other so-called mud crabs that are not pursued by divers and commercial crabbers. Dead stone crabs and stone crab shells were seen washed up on shore at IR Sites 7 and 8 during the June 1996 site visit, and crab traps (floats) were also seen in these areas generally 50 meters or more from shore. It may be possible to collect juvenile stone crabs near the shoreline. As noted previously, a variety of fish feed on crabs in estuarine and marine waters.

4.5 OYSTERS

Flat tree oysters (*Isognomon* sp.), sometimes referred to as "mangrove" oysters, are found at several SWMUs and may be present at some background sites and at AOC 8. They range from south Florida to Brazil. These oysters are very flat and thin shelled, and are found growing in clumps on rocks and on the roots of mangroves, most often the prop roots of the red mangrove. Like all bivalves, tree oysters are filter feeders that pump water through their gills and strain out microscopic organic matter. A number of south Florida fish species are known to feed on mollusks and may feed to some extent on mangrove oysters. These include pigfish, sheepshead, pinfish, Atlantic croaker, and black drum.

4.6 SPINY LOBSTER

The spiny lobster (*Panulirus argus*) supports major commercial fisheries in south Florida and the Caribbean. It feeds on a variety of slow-moving animals, including gastropod and bivalve mollusks, crustaceans, and echinoderms. The spiny lobster spawns in offshore waters along the fringes of reefs in late spring and early summer. Planktonic larvae inhabit the open ocean and, after metamorphosing into post-larvae (which swim rather than drift), move shoreward. After another series of molts, benthic post-larvae become juveniles that hide among seagrass beds, rocks, and rubble. Late juveniles and adults aggregate in sheltered areas in protected bays and estuaries with high salinity. Sheltered areas include mangrove roots, holes in limestone rock, rocky outcroppings and ledges. Many lobsters approaching sexual maturity emigrate offshore in the spring, dispersing along the reefs that parallel the Florida Keys. Research indicates that more females than males emigrate offshore. There is apparently a return migration to shallow waters after larvae are released in early summer. Adults remain in shallow waters until fall, when water temperatures drop and fall storms arrive. At this time, adults of both sexes move offshore to deeper waters. Octopi, crabs, and small fish feed on early benthic stages (post-larvae). Large predators (groupers, jewfish, sharks, and sea turtles) prey on both juvenile and adult lobsters. Spiny lobsters were observed at IR 8 in June 1996, and may be sampled if present in sufficient numbers.

4.7 GASTROPODS

The Class Gastropoda includes snails, limpets, periwinkles, conchs, and whelks. Representatives of each of these groups are found in the Florida Keys and the Caribbean. Snails were observed in rocky, intertidal areas of IR Sites 1, 7, and 8 in June 1996. Specimens were collected and attempts are being made to identify the species. Two conch species, *Strombus gigas* and *Strombus raninus*, were found in seagrass beds adjacent to IR 7 and IR 8. Tissue samples from snails may be analyzed if (1) snails are numerous

enough to yield sufficient tissue and (2) there is adequate life history information on the species in question to permit interpretation of tissue levels of contaminants. The use of conchs as a species for collection is uncertain because numbers have been drastically reduced by over-harvesting.

5.0 SAMPLING PROCEDURES AND PROTOCOLS

Biological samples will be analyzed for metals, pesticides, and PCBs. Based on previous experience with fish and oyster tissue from Boca Chica Key, analyses will not be conducted for volatile and semivolatile organic compounds. During January, 1996, fish and mangrove oysters were collected from background and SWMU sites on Boca Chica Key and analyzed for a wide range of contaminants. No volatile or semivolatile compounds were detected in any of the 60 fish and oyster samples collected from SWMU sites. No volatile compounds were detected in any of the 56 fish and oyster samples collected from three background sites. Semivolatile compounds detected in tissue from background sites were limited to bis(2-ethylhexyl)phthalate in 5 of 53 fish, phenol in 4 of 53 fish, and pyridine in 4 of 53 fish and in 3 oyster samples. Because of the low concentrations detected and the extremely low frequency of detection of volatile and semivolatile compounds, analyses of these compounds will not be conducted on tissue collected during the present study.

Small fish will be collected using seines, dip nets, and funnel traps. Larger fish will be collected where available at inland sites such as AOC-B, using gillnets. Crabs will be collected using standard crab traps. Sea urchins, clams, oysters, conchs, and lobsters may be collected by hand where available in shallow water. Appropriate collection permits will be obtained. All samples will be collected, frozen, and shipped to the analytical laboratory in accordance with established chain-of-custody procedures.

There is a possibility that key silversides (*Menidia conchorom*) and mangrove rivulus (*Rivulus marmoratus*) occur at some sites. The Florida Game and Fresh Water Fish Commission lists the key silversides as threatened and the mangrove rivulus as a species of special concern. If any individuals of either of these species are captured, they will be immediately released.

5.1 GENERAL AQUATIC SURVEY

General field observations of physical conditions (water depth, bottom type, cover type and extent, channel/basin morphology) and diurnal field measurements of physical/chemical water quality parameters (pH, conductivity/salinity, dissolved oxygen, and water temperature) will be made using portable field instrumentation at each site at least once during the sampling period to assist in interpretation of tissue sampling results.

Fish will be removed from collection devices at frequencies appropriate to minimize fish mortality or deterioration. Other aquatic samples (shellfish and sea urchins) will be collected by hand or with substrate

rakes. Only live organisms will be taken. Upon collection, samples will be identified to species and enumerated. In this process, priority will be given to segregating and returning to the source water as soon as possible any special status species (e.g., key silverside, mangrove rivulus) noted in the collection to minimize the potential for mortality. Individuals of species targeted for tissue analysis will be segregated by species in plastic bags and placed on wet ice immediately for later processing, as noted below. Standard measurements (total length, etc.) will be obtained for individuals of remaining (non-target) species as appropriate to provide indication of general health of resident populations (e.g., presence of multiple size classes, evidence of stunting, etc.). Healthy non-target fish will be returned to the source waterbody; expired or disabled fish will be disposed of in accordance with provisions in the scientific collecting permit issued for this work. Any observed physical abnormalities (e.g., lesions ectoparasites, fungal/bacterial infections) will be documented during the collection of the biological samples.

General field observations, sampling/measurement parameters and methods (e.g., gear type, methods, calibration data, sampling times, responsible crew member) and resulting sampling/measurement data (e.g., physical/chemical measurements; fish and shellfish species composition, abundance, lengths, weights) will be recorded in ink on standard aquatic field survey data sheets. A formal field notebook will be maintained to document field activities, including any problems and deviations from plans and procedures, with appropriate references to standard data sheets, for all field sample collection and processing activities (i.e., general aquatic survey and tissue sample collection and preparation).

5.2 TISSUE SAMPLE COLLECTION AND PREPARATION

Laboratory chemical analyses will be conducted on whole-body samples of fish, small crustaceans, and soft-shell crabs. Analyses of soft tissue (muscle/viscera) will be conducted on bivalves, sea urchins, blue crabs, stone crabs, and large crustaceans. The soft tissue will be removed from these organisms at the testing laboratory.

Sample collection and preparation for tissue analysis will be conducted in accordance with Florida Department of Environmental Protection (FDEP) standard operating procedures (FDEP 1992) and relevant guidance (e.g., EPA 1981, 1993) to the extent appropriate for whole fish and shellfish analysis for ecological risk assessments. Any deviation from FDEP SOPs will be discussed and resolved with FDEP prior to sampling. Essential elements of this protocol are as follows:

Sample Composition - Organisms potentially useful as samples for tissue analysis will be segregated by species and size class, placed in plastic bags, temporarily labeled, and placed on wet ice upon collection.

Each sample will consist of a single species and may consist of one or more individuals, depending on sampling success and minimum sample weight requirements for analysis. A minimum of 30 grams per sample is established as an initial target; final minimum weight requirements will be established in consultation with the selected analytical laboratory. Other organisms useful as samples will be segregated by species and size class, and processed as described above.

Preservation of Sample Integrity - All reasonable efforts will be made to preserve sample integrity in collecting, processing, preserving, and packaging samples for shipping by preventing loss of contaminants from samples, by preventing contamination of these samples from other sources, and preventing deterioration of tissue. Specific measures will include (1) segregating individual fish or fish in a size class potentially comprising separate samples in plastic bags upon collection; (2) decontaminating sampling equipment that could potentially come in contact with samples (e.g., measuring boards, balances) using Liquinox, Alconox, or comparable detergent and rinsates as required by FDEP SOPs prior to initiating sampling, between sampling sites, and between processing of individual samples; (3) wearing disposable gloves for processing and changing gloves as necessary to minimize cross-contamination; and (4) packaging samples or sample components separately for shipment. Care will be taken during collection not to breach individual shellfish shells with sampling equipment, such as rakes or knives. Only live individuals will be taken. Proper decontamination procedures and cross-contamination avoidance methods will be employed during shellfish collection, as per EPA guidance (EPA, 1993).

Sample Processing, Packaging and Shipping - Tentatively designated biological samples (consisting of appropriately segregated, bagged, and tagged specimens placed on wet ice upon collection) will be processed and packaged for shipment as soon as possible after collection. Individual specimens will be measured for wet weight and maximum total length. Only length ranges and total weight will be recorded for composite samples of enumerated small fish specimens. Data will be recorded on standard field data sheets. Sample specimens will then be wrapped in extra-heavy-duty aluminum foil (spines will be clipped before wrapping to prevent puncture of packaging). If deemed acceptable based on discussions with FDEP and the analytical laboratory, composite samples consisting of numerous small specimens might be wrapped as unit samples. A standard sample identification tag will be completed and taped to each foil package, which will in turn be sealed in a plastic bag and either frozen for later shipment or packed in ice for immediate shipment. Frozen samples will be packed in dry ice to ensure they do not thaw prior to receipt by the analytical laboratory; arrangements will be made to ensure that fresh samples shipped in wet ice will be received by the analytical laboratory within 24 hours of collection. Each sample package (e.g., ice chest) will be sealed for shipment and will be accompanied by a properly completed chain-of-custody form. The laboratory will be consulted prior to field collection to ascertain the proper number of

individuals and/or weights needed for each species for each sample. All relevant sample data specified by EPA (1993) will be recorded on standard field data sheets. Each sample will be accompanied by the properly completed chain-of-custody form.

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